

### LA-UR-21-21409

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Pressurizing Hagan and SAVY containers to 30-psig (air) to measure the release of analytical cerium oxide test powder Title:

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Internal Los Alamos report. Intended for:

Issued: 2021-02-16





# **Conduct of Engineering Calculation Cover Sheet**

Calculation No.: CAL-21-TA55-CNTRC-008-M Rev:0 Page 1 of 58 Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig (air) to measure the release of analytical cerium oxide test powder

1.0 INITIATION		
1.1 Calculation Status: Prelimi	inary ☐ Final ⊠	
1.2 DCF No.: N/A	DCF Title: N/A	
1.3 Project ID No: N/A	Project Title: N/A	
1.4 Superseded Calculation No.: N/A		
1.5 Facility Name(s): Plutonium Facility	1.6 Organization: RP-SVS	
1.7 Structure/ System ID: CNTRC	1.8 Structure/ System Name: Credited Conta	niners
1.9 Component ID: N/A	1.10 Component Name: N/A	
1.11 Structure, System, or Component Nuclea	ear Functional Classification	
SC ⊠ SS □ OHC □	NS N/A	
1.12 Structure, System, or Component Manag	gement Level	
ML-1 ⊠ ML-2 □ ML-3 □	] ML-4 □ N/A □	
If "N/A" is checked then explain:		
1.13 Associated with Technical Baseline:	Yes ⊠	No 🗌
1.14 Is Cover Sheet being used to document organization?	a calculation from an external Yes	No 🖂
If yes, mark "N/A" in Field 3.2 Verifier and add	d description below.	
Description:		
2.0 SECURITY CLASSIFICATION REVIEW		
	not Contain LICNII	
2.1 Security Classification: Unclassified/Does		
2.2 DC/RO: (Name, Z Number, Organization,	, Signature, Date)	
Tristan McDonald, 189940, ES-55		

Effective Date: 05/30/19



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#### 3.0 APPROVALS

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	4 11	KE(412 LEKEL)	PROFESSIONAL	<b>FN(-INFFR</b>	SEAL:

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5.0 RI	5.0 REVISIONS					
Rev	Date	Description of Change(s)	Preparer	Verifier	RM	FDAR
0		Original Issue				

AP-341-605-FM01 Rev. 4 Effective Date: 05/30/19





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analytical cerium oxide test powder.

#### 1.0 PURPOSE

The need to pressure-test known nuclear material storage containers has been made apparent by the CSE (cognizant systems engineer) assigned to containers at TA-55. The main goal of the current study is to understand the behavior of the SAVY-4000 and Hagan containers during an internal pressurization (30 psig) event. The experiments incorporated a nominal mass of 100 g of  $CeO_2$  (cerium oxide) powder to simulate MAR (material at risk) conditions. For the experimental results with mass losses of  $0.0\pm0.1$  g mass loss), using ASME error analysis, there is a total expanded uncertainty in a 95% confidence interval ( $\pm0.25$  g) for the tested SAVY-4000 and Hagan containers. For purposes of conservatism, this has been rounded upward to yield a bounding value for the damage ratio DR = 0.003 = 0.3%.

#### 2.0 METHODOLOGY

An experimental system was developed to deliver a pressure pulse that mimics a scenario of the bursting of a sealed source inside a Hagan or SAVY storage container. Six tests were done with 5QT SAVY-4000 and six tests with 8QT Hagan containers (Table 1). Note two different SAVY lids were subjected to three successive test insults (each SAVY filter received three insults). The Hagan container filters only received one test insult per filter (Table 1).

This was a test series performed in December 2020, and the Dec 2020 test is a repetition of a similar test done in October 2020. Therefore, all of the individual filters had been challenged multiple times with 30 psig pressure pulses and CeO<sub>2</sub> test powder.

Before the tests, the filters were visually inspected, and all containers, lids and O-rings were in good physical condition.

Test indices for the 30-psig pressurizations	Container type and lid ID number
SAVY 1 <sup>st</sup> , 2 <sup>nd</sup> , 3 <sup>rd</sup> (three insults per filter)	5QT SAVY; Lid # 081305135L
SAVY 4 <sup>th</sup> , 5 <sup>th</sup> , 6 <sup>th</sup> (three insults per filter)	5QT SAVY; Lid # 012005142L
Hagan 0.625" diameter filter (one insult per filter)	8QT Hagan body 08-06-08154
	Filters:
2 <sup>nd</sup> , 3 <sup>rd</sup> , and 4 <sup>th</sup> tests	(2 <sup>nd</sup> ) NUCFIL-019 2-08 LANL 2143
	(3 <sup>rd</sup> ) NUCFIL-019 2-08 LANL 3012
	(4th) NUCFIL-019 2-08 LANL 3029
Hagan 0.375" diameter filter (one insult per filter)	8QT Hagan body 08-06-08154
	Filters:
1 <sup>st</sup> , 5 <sup>th</sup> , 6 <sup>th</sup> tests	(1st) NUCFIL-013 09-06 LANL 559
	(5 <sup>th</sup> ) NUCFIL-013 10-02 LANL 2062
	(6th) NUCFIL-013 10-02 LANL 2213

Table 1. Test indices correspond to the sequential insults on the filters.

To prepare a container for a pressure insult test (Table 2), an empty test container with attached pipe fittings (Figure 1) was placed on a mass balance (Mettler Inc; Columbus OH; model SR64001; Los Alamos S&CL ID #028289; calibration due 4-27-2021). The rated instrument uncertainty is ±0.1 g.

The mass balance was then tared to a zero reading, and cerium oxide (CeO2) powder was loaded into a nozzle in the container (Figure 1 and 2) to a nominal weight of  $100\pm2$  g. Then the gross weight of the "container and fittings and powder" assembly was measured (to a resolution of  $\pm$  0.1 g) and photographed before each test. After the pressure pulse test, the "container and fittings and powder" assembly was weighed and the display weight was photographed after the test.





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Figure 1. Cerium oxide powder inside a SAVY container before a pressurization test.

Table 2. Dry weights of tested containers

Tested container types	Empty container mass
5QT SAVY, with piping fixtures	3645.6
8QT Hagan 0.625-dia filter, with piping fixtures	3591.1
8 QT Hagan 0.375-dia filter, with piping fixtures	3486.0

A 47 mm filter holder (model RVPH-20 HI-Q Inc San Diego CA) with a honeycomb backing mesh (4 mm diameter openings) was used to support a stainless steel mesh (Fisher Sci 59-004648-0010) screen (125  $\mu$ m holes, and 23% open area fraction). The RVPH-20 filter holder has a 42 mm effective diameter, but the custom nozzle flares out to an opening with a 47 mm diameter (Figures 2 and 3). Note the direction of air flow in the nozzle (for these tests) is reverse to the intended direction, if this were an air sampling application.



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Figure 2. HI-Q Inc 47 mm filter holder, steel mesh screen and custom 47 mm diameter nozzle.



Figure 3. Assembled nozzle system.

The containers were attached (Figure 4) to an intermediate (ASME rated) pressure vessel (Drierite Inc model 106-C) and installed (Figure 5) into the Los Alamos RRFMC (Respirable Release Measurement Chamber).

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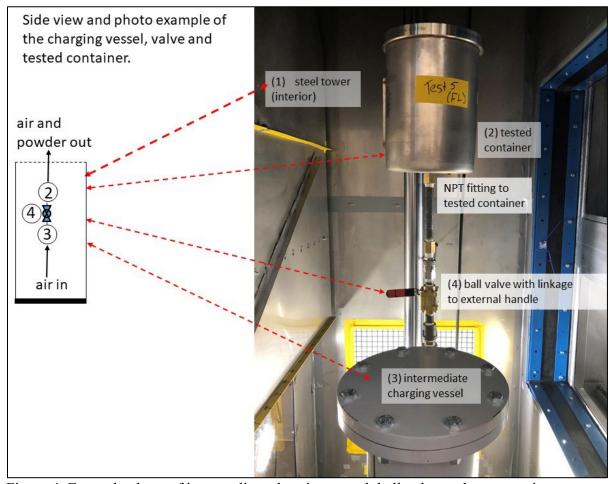


Figure 4. Example photo of intermediate charging vessel, ball valve and test container.

The RRFMC (Moore Tao and Karns 2018) is a drop tower system (Figure 5) integrated into a HEPA filtered aerosol wind tunnel that satisfies NQA-1 subpart 2.4 for R&D work (LANL RP-SVS-RIC-TP-100 "Respirable Release Fraction Measurement Chamber RRFMC (drop tower) procedure"). It drop-tests nuclear material storage containers loaded with cerium oxide powder and measures the released respirable aerosol (< 10  $\mu$ m AED, aerodynamic equivalent diameter, US DOE 2008) and airborne aerosol, (< 20  $\mu$ m AED, US DOE 1994). The measurement limits are between 0.3  $\mu$ m and 20  $\mu$ m AED with an APS (Aerodynamic Particle Sizer) unit (TSI Inc. Shoreview MN).

After the container was loaded into the RRFMC, the access door was closed and the APS (Figure 6) was started before the pressure pulse test to gather background aerosol measurements and establish a baseline. The intermediate pressure vessel was charged to slightly more than the 30-psig test value, with allowance for the combined volumes of the intermediate vessel and the tested container. To pulse the container and evacuate the CeO<sub>2</sub> test powder out of the nozzle, a ball valve was manually cycled over a one-second interval (opened and closed) using a mechanical linkage from outside the drop tower. The combined volume of the intermediate vessel and the tested container would equilibrate to the 30-psig test pressure, and the APS then measured any released aerosol in the downstream portion of the wind tunnel.





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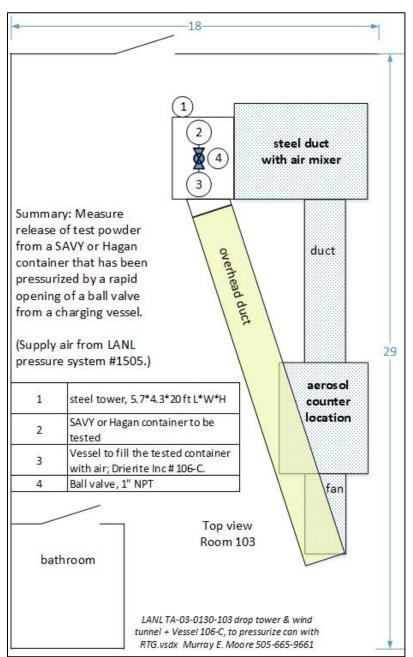


Figure 5. Tests conducted in the LANL RRFMC (Respirable Release Fraction Measurement Chamber).





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Figure 6. TSI Inc. model 3321 APS Aerodynamic Particle Sizer

The RRFMC drop tower was designed for container drop tests with an integrated pressure system, approved LANL pressure system ID number, and individual components that are operationally pressure rated. For these pressurized powder tests, the existing Drierite 106-C air drier (already contained in the pressure system) was repurposed (it is an ASME-rated pressure vessel) as the intermediate charging vessel for safe operation of these tests. The Drierite 106-C is normally used to supply ultra-dry airflow for experiments involving liquid droplet aerosol generation. Liquid droplet aerosol generation was not relevant to these tests, and the drop tower was retrofitted for the pressure pulse testing activities.

The first pressurized powder test used a two gallon pail (Cary Co. model #26W098) with a 1-mm diameter orifice in the lid of the pail (Figure 7). A 0.5-mm diameter orifice would have the same pressure drop characteristics as a nominal Hagan or SAVY filter, i.e. about a 0.6 inWC (inches of water column) for an airflow rate of 0.2 ALPM. For this current project, only an orifice of 1-mm diameter was possible, given the time allowed for this effort.



Figure 7. Two gallon (#26W098) pail (Cary Co., Addison IL)

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### 3.0 ACCEPTANCE CRITERIA

The test results can be used to evaluate acceptance criteria for the experimental methodology and container studies.

Eight of the twelve tested (Hagan and SAVY) containers (Table 3) had zero measurable released mass (net differences of  $0.0\pm0.1$  g before and after the pressure tests). Although a loss of mass is expected for these tests, four of the twelve tests indicated a mass gain on the digital mass balance readout (i.e.  $M(pre) - M(post) = -0.1\pm0.1$  g. For the damage ratio DR calculations, this "mass gain" is interpreted as a zero value. The values of -0.1 g are within the resolution of the mass balance device (Table 3). Note the negative mass differentials are non-real because the final measured mass is greater than the initial mass by 0.1 g.

Table 3. Measurements of pretest and post-test fixture masses. Note that the operator would record the visually averaged data fluctuations, while photographs capture instant values.

	Datasheet log		Differential loss of mass, g	Photo log	
Container Index	Pretest, g	Post test, g		Pretest, g	Post test, g
Hagan 1	5150.9	5150.9	0.0	5150.9	5150.8
Hagan 2	5239.8	5239.8	0.0	5239.8	5239.8
Hagan 3	5339.4	5339.4	0.0	5339.4	5339.4
Hagan 4	5416.0	5416.1	-0.1	5416.1	5416.1
Hagan 5	5388.0	5388.1	-0.1	5388.0	5388.1
Hagan 6	5415.6	5415.7	-0.1	5415.6	5415.7
SAVY 1	4590.5	4590.5	0.0	4590.5	4590.5
SAVY 2	4604.4	4604.4	0.0	4604.4	4604.4
SAVY 3	4623.9	4623.9	0.0	4623.9	4623.9
SAVY 4	4644.4	4644.4	0.0	4644.4	4644.4
SAVY 5	4734.3	4734.4	-0.1	4734.3	4734.3
SAVY 6	4826.0	4826.0	0.0	4826.0	4826.0

SAVY 5th. Note a transcription error on the logsheet for SAVY test #5. The post-test photo captured the correct mass as 4734.3 g.

The experimental values were aggregated together, by container type, and the average loss of mass was calculated (Table 4). The random uncertainty (i.e. standard deviation of the samples), random standard uncertainty (Sx-bar) and the systematic error (Bx) of the mass balance instrument (0.1 g) were included to estimate Ux, the total expanded uncertainty (ASME 2013). This interval (±Ux) is expected to contain the true value to 95% confidence:

$$Ux = t^*[(Bx)^2 + (Sx-bar)^2]^{1/2}$$

Eq. 1

where t = 2.447 = t-critical; 95%; two-tailed distribution; N=6 samples (Milton and Arnold 1986).

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For the Hagan and SAVY containers in this study, the sample size is N=6, while the ASME approach assumes sample sizes N≥30. The t-critical=2.447 value accounts for this distinction.

When the two types of Hagan containers (0.375" filter and 0.625" filter) were tested, the release of respirable aerosol mass was within one error bar of each other (Figures 9, 10 and 13). Consequently, for purposes of the estimated DR, the two Hagan container types were combined into a single estimate for the DR value (Table 4).

Table 4. Average test values, aggregated by container type

Tested container types	AVG mass difference, g	Sx, random uncertainty (std deviation)	Sx-bar, random std uncertainty, Sx/sqrt(N)	Bx, systematic uncertainty	Ux, 95% confidence, total expanded uncertainty
Hagan filters (6 total)	-0.0500	0.0548	0.0224	0.1	0.251
SAVY filters (six total)	-0.0167	0.0408	0.0167	0.1	0.248

Compared to the nominal test powder MAR mass of 100 g, less than 0.1% of the powder test mass was released. For this calculation, the measured mass loss is zero (0.0 g), but the total expanded uncertainty was utilized. Following the methodology from the initial series of tests on SAVYs and Hagans done at SwRI (Southwest Research Institute) for drop and fire insults (McDaneld 2012), the damage ratio can be calculated as:

$$DR = 1 - \frac{M_{post}}{M_{pre}}$$

Eq. 2

where,  $M_{post}$  = post test mass and  $M_{pre}$  = pre test mass.

For example, if the mass loss is  $0.0\pm0.3$  g, the worst case estimate for the mass loss would be 0.3 g. Then the DR = [1-(99.7/100)]\*100% = 0.3%.

For the test series for this calculation, engineering judgment is used to estimate a bounding value for the DR, based on the averaged results, random error and systematic uncertainty (Table 5). (To be explicit, the worst case mass loss is taken to be the value of Ux, the total expanded uncertainty.)

Table 5. Calculated DR damage ratio, and the bounding value, rounded upward for conservatism.

Tested container types	DR, Damage Ratio, 95% confidence	DR%, Damage Ratio, 95% confidence	DR% Conservative Bounding Value
Hagan filters (6 total)	0.00251	0.25%	0.3%
SAVY filters (six total)	0.00248	0.25%	0.3%





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For the 2 gallon Cary™ container (Figure 8A and 8B), with the 100.0 g test load of powder, the container lid was dislodged (Figure 8C), 42.5 g of powder was retained in the container (Figure 8D), and the total released mass value was 57.5 g. The 2 gallon Cary™ container test was performed to generate a representative result, and the measurements were only used as a point of general comparison.



Figure 8A.



Figure 8B.



Figure 8C.



Figure 8D.

Figure 8. Photos of the Cary<sup>TM</sup> can before the test (8A), after the test (8B), the lid after the test (8C) and measurement of the powder retained in the container (8D).



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The APS system produces tabular and graphical outputs of aerosol particle size and mass concentrations. Figures 9 and 10 give a snapshot from one Hagan container, and Figures 11 and 12 are from one of the SAVY tests.

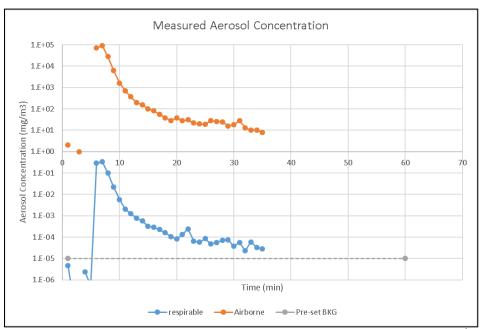


Figure 9. Aerosol concentration versus time (test pulse at 6 min) for "2<sup>nd</sup> Hagan".

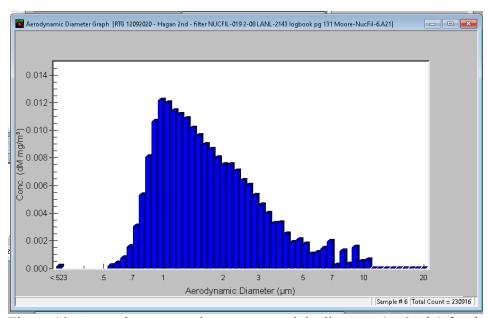


Figure 10. Aerosol concentration versus particle diameter (at 6 min) for the "2nd Hagan".



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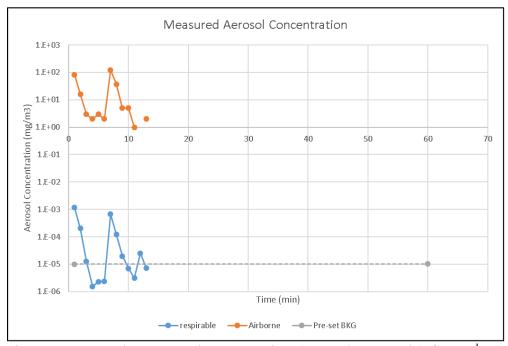


Figure 11. Aerosol concentration versus time (test pulse at 7 min) for "2<sup>nd</sup> SAVY". (RTG 12092020 - Hagan 2nd - filter NUCFIL-019 2-08 LANL-2143 logbook pg 131 Moore-NucFil-6.xlsx)

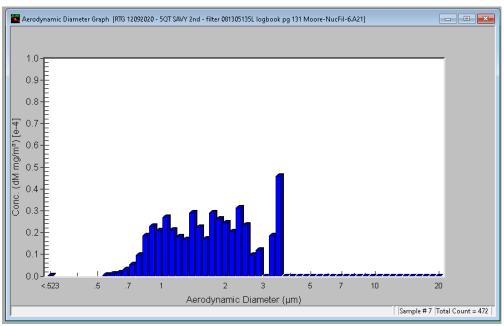


Figure 12. Aerosol concentration versus particle diameter (at 7 min) for "2nd SAVY".





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#### 4.0 UNVERIFIED ASSUMPTIONS

There are no unverified assumptions in this calculation.

#### **5.0 ASSUMPTIONS**

The tests used a one-second pulse of air that was initiated by the manual turn of a ball valve. The valve handle was connected to a manual linkage. The operator was therefore outside of the airtight test chamber. The one-second air pulse is assumed to be representative of a rapid pressurization of gases inside a container.

Air is the operational experimental gas for these tests, and there is entrained CeO<sub>2</sub> powder inside the container, with measured trace amounts that were transported into the aerosol wind tunnel. For experimental tests, the mixture of air and test powder is assumed to be closely match the gaseous conditions in a hypothetical release.

#### **6.0 LIMITATIONS**

When calculation use is consistent with the objective, there is no limitation associated with this calculation.

#### 7.0 CALCULATION INPUTS

- (1) Effective shape factor-corrected density of CeO<sub>2</sub> particles (0.68 g cm<sup>-3</sup>) for AIM software with the APS spectrometer (Moore and Tao 2020).
- (2) Use the Stokes Correction Factor in the TSI Inc AIM software for the APS spectrometer, since the particle density is less than 0.9 g cm<sup>-3</sup>.
- (3) RRFMC system air flow rate (FR, m<sup>3</sup> s<sup>-1</sup>) measured by TSI Inc 9565P anemometer.
- (4) The first and last column letters in the raw data table of the Excel spreadsheets correspond to the time of the start of the pressure pulse and the time of the reestablishment of the particle background equilibrium, respectively.

#### 8.0 COMPUTER HARDWARE AND SOFTWARE

Operation system: Microsoft Windows 10.

Software: (1) Microsoft Excel

(2) Aerosol Instrument Manager Software for Aerodynamic Particle Sizer (TSI Inc Shoreview

MN).

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#### 9.0 SUMMARY AND CONCLUSIONS

For the observed experimental results of zero loss of mass (0.0 $\pm$ 0.1 g), and a total expanded uncertainty (in a 95% confidence interval of  $\pm$ 0.25 g), the conservative bounding value of the DR = 0.003 = 0.3% for the SAVY and Hagan containers. (See Table 5 for details.)

The released mass, respirable mass and airborne mass of  $CeO_2$  test powder are measured for the rapid (about 1 second) pressurization (to 30 psig) of SAVY and Hagan containers. The aerosol background concentrations in the test chamber (wind tunnel) are measured before each test. The background values are within about an order of magnitude of each other.

Note each SAVY filter received three separate pressurized insults, while the Hagan filters received only one (each) pressure pulse insult.

The APS measured the net respirable and net airborne mass (Table 6). Note the APS is capable of measuring much smaller values of test powder than the Mettler mass balance (Table 6).

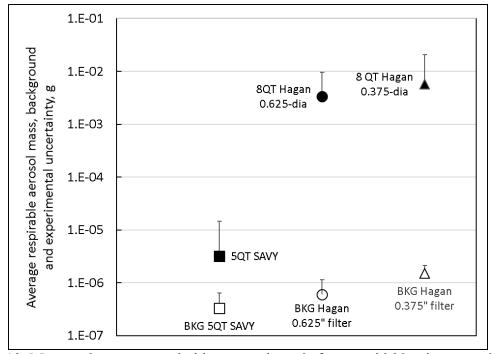


Figure 13. Measured average respirable mass released after a rapid 30 psig pressurization. Six measures were done for the SAVY type, and three measures for each of the two Hagan types.





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Aerosol backgrounds were measured for all tests, and positive error bars indicate the experimental uncertainty.

Table 6. Measured released mass, respirable mass and airborne mass. Aerosol backgrounds were

measured for all tests, and the experimental uncertainty for each container type is shown.

Because the test mass was 100 g of powder, these gram quantities are also the "percent" values.	Net released mass <sup>1</sup> , g	-	Uncertainty respirable mass (net) <sup>2</sup> , g	Net airborne $\pm$ uncertainty airborne mass mass <sup>2</sup> , g (net) <sup>2</sup> , g
5QT SAVY Avg and Combined Uncertainty	$0.0 \pm 0.25 \; \mathrm{g}$	3.22E-06	± 1.15E-05	$1.02\text{E-}05 \pm 4.45\text{E-}05$
8QT Hagan 0.625-dia filter. (Average and Combined Uncertainty)	$0.0 \pm 0.25 \mathrm{~g}$	3.37E-03	± 6.23E-03	$3.51E-03 \pm 6.45E-03$
8 QT Hagan 0.375-dia filter (Average and Combined Uncertainty	$0.0 \pm 0.25 \; \mathrm{g}$	5.77E-03 :	± 1.48E-02	5.93E-03 ± 1.52E-02

(1) 95% total expanded uncertainty with testing and mass balance SR64001 (Mettler Inc. (Columbus OH).

(2) With testing and a Model 3321 APS Aerodynamic Particle Sizer (TSI Inc Shoreview MN).

From a structural standpoint, the SAVY-4000 and the Hagan container performed very similarly. After the 30-psig test pulses, there were no visual indications of bulging of the container body in either container type. The SAVY-4000 container was tested in other pressure related work at New Mexico Tech, where the container was exposed to pneumatic and hydrostatic pressure insults. In those tests, the SAVY-4000 containers began showing visual signs of plastic deformation at approximately 60-psig from internal pressure insults. Since this current work did not approach that internal 60-psig pressure, we were confident that complications would not arise.

However, we did not have the same history of knowledge for the Hagan, as this specific type of "pressure pulse" test had never been conducted. In the current test, the Hagan still performed well in this respect, and did not indicate deformation or bulging for an estimated force of 1,100 lbf on the internal face of each lid.

For all the tests, this force impulse did not have an apparent negative effect on the structural performance. This is a key result, as the pressure pulse did not permanently disfigure the sealing surfaces and method of closure, therefore maintaining and reproducing the performance of their respective design functions. Upon completion of each test, the sealing surfaces of each container were inspected for damage, unrecoverable debris lodged in the filter media, and general damage to the filter media etc.

The Hagan filter media is an area of concern when evaluating the complete container performance. In the current tests, both of the SAVY and Hagan filters captured the expelled surrogate material with differing levels of effectiveness and the filter media remained intact. In the case of the Hagan, the carbon fiber media is directly exposed to the incoming powder in a single circular cross section. However, the physical impact of the powder did not dislodge any visible piece of the filter media, and the filter components retained their structural rigidity.



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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of

analytical cerium oxide test powder.

In the SAVY container, the filter material has less direct exposure to powder because of the recessed smaller holes in the filter cup. During the pressure pulse tests, powder impacted onto the filter media during the tests. The small diffusion holes in the filter cup assembly allowed multiple locations for the test powder to cling to the filter material. Impacted powder was removed after tests two and three, and tests five and six respectively. However, even with a HEPA-filtered vacuum cleaner, there were small amounts of material that could not be removed. This powder was not observed to build up and clog the filter during the subsequent tests. This topic has been an area of concern in the past regarding filter performance due to corrosion inside of the container during normal Los Alamos storage conditions.

A measure of the bulk released mass with a mass balance (resolution ±0.1g) yielded a zero net release of 0.0±0.25g of test powder. Uncertainty calculations within a 95% confidence interval, combined with an upward rounding for conservatism yields a bounding value for the damage ratio DR=0.3%.

For measurements of the suspended respirable aerosol (< 10  $\mu$ m AED), the SAVY-4000 container allowed the passage of about  $3x10^{-6}\%$  of the challenge powder material, and the Hagan allowed the passage of about  $1x10^{-2}\%$  of the challenge powder material.

The LANL facility operations and safety basis personnel can utilize this information to determine if these containers are viable storage systems. The performance of these containers is important for laboratory safety, and this information is valuable for the container designers to ensure a viable and reliable product for the TA-55 PF-4 facility and for the DOE complex at large.



### Conduct of Engineering Calculation

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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of

analytical cerium oxide test powder.

#### 10.0 REFERENCES

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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of analytical cerium oxide test powder.

#### 11.0 CALCULATION

Net aerosol mass (LANL RP-SVS-RIC-TP-100) measured by the system is:

$$m(aerosol) = C_P(\frac{g}{m^3}) * FR(\frac{m^3}{min}) * T_S(min)$$

Eq. 1

 $C_P$  = respirable or airborne aerosol concentration measured by the APS system and corrected for aerosol deposition losses in the wind tunnel (g/m<sup>3</sup>),

FR = RRFMC total air flow rate, measured in the duct upstream of the APS (m³/min), and, Ts = APS sampling interval (1 min).

The deposition losses in the wind tunnel are accounted by a correction factor involving the measured aerosol penetration (Tao and Moore 2018) in the wind tunnel from the aerosol release location to the aerosol measurement location. For the 52 (fifty two) measurement bins (j) between 0.3  $\mu$ m and 20.0  $\mu$ m AED in the APS system, the aerosol concentration Cp(g m<sup>-3</sup>) is estimated as:

$$C_P = \frac{C_{UNC}}{P_j}$$

Eq. 2

where  $C_{\text{UNC}}$  is the uncorrected aerosol concentration measured by the APS aerosol particle counter, and the aerosol penetration  $P_j$  at bin (j) for an aerodynamic diameter  $D_j$  ( $\mu$ m) is:

$$P_j = \exp(-0.0032 Da_j^2 - 0.0681).$$

Eq. 3



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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of

analytical cerium oxide test powder.

#### 12.0 APPENDIX A – SUPPORTING INFORMATION

	Preliminary Steps HAGAN 15T	Note	Operator number	Assistant number
1	Walk through room 103 and organize work area.			
2	Record the date, operator, logbook name & page.		1	
3	Record serial number and volume of test can.		- x*-	2
4	Note room temp (deg F).	7008	1	
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a			
6	Calculate charging pressure for gray 9-gallon Drierite 10		1	
7	Note charging pressure (psig): (37)	Pressure (psig):		
8	Ensure vessel 106-C will not initially be pressure charged		1	
9	Note valve V5 is open, to not charge vessel 106-C.		0	
10	Note valve V6 is closed, to not charge vessel 106-C.		1	
	In Process Steps			
11	Prepare container to be tested.			2
12	Install test can above ball valve on vessel 106-C.			2
13	Close and lock tower door. Seal with "In Use" yellow tag	pe.		2
14				
15	Turn on air compressor.		1	
16	Adjust regulator PCV1 and use PRV1 to set charging pres	ssure, if needed:	1	
17	Set and record wind tunnel speed (Hz):	27,0 HZ		
18				
19	Note valve V5 is closed, to charge vessel 106-C.		1	
20	Note valve V6 is open, to charge vessel 106-C.		1	
21	Verify gray vessel Drierite 106-C is pressurized.	90 NOG 2 27 11 40	1	
22		go nogo gauge	-	
23	Verify charging (system) pressure on PI3(31 ps iv	Pressure (psig):	1	+
_	Turn aerosol particle counter on.	428PM		
24	Create filename with format: Logook and page, test seri	es and ID info.	1	
25	Start AIM software for drop test sampling (60 sec count,		1	
26	Pre-drop BKG concentration validation. Note five cycles			
27	SN: 08-06-08154 Body	FILES NUCFIL-013	09-06	LANL SS
28	Toggle ball valve above gray vessel Drierite 106-C for a c	one to two second pulse.		
29	Note sample number of aerosol particle counter.	Sample number at pulse: (37)		
30	Pre-Test Total Mass 5150.810			
	Post-test Steps 5150, 9a			
31	Save data files, record file names and location	145×10-4 mg/m3		
32	Save data files, record file names and location  Verify background is about 1.0E-5 mg/m^3 before open	ing door. FULL 90 MIN.		
33	Open RRFMC door	1071 5 0511		
34	(Optional) DR measurement			
35	(Optional) DR Measurement filter.			
36	Turn air compressor off and open bleed valve.			
37	Perform post-test activities		1	
38	RRFMC data analysis and test report.	012 -0.00 -0.11	1	11
	RTC 12082020-Hagen 1st-filen NCJCF	112-013 09-06 CANL-557 1	a pool b	13 1 MODIE
	Date: 12-8-2020	Assistant 2: T DAV LS		
	Logbook: 0, 131 Morre motil (0	Assistant 3:		
	Logbook: 0.131 More Mety (a Operator 1: ME Mothe	Assistant 4:		
	Note: Only record the operator number after completic	on of the step.		
	Carlos al 3 (Da un-land) 2 (M)	- 5mg . @1 5mg/ @1:	7	1 -

Post Test Total Moss 5150,9 or 570.





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	Preliminary Steps	HAGAN 2ND	Note 7523 BLEKAGE HORFE AT 1523 BLEKAGE HORFE	Operator number	Assistant number
1	Walk through room :	103 and organize work area.	A1 8 122 1122 1 123 131		
2	Record the date, ope	rator, logbook name & page.		1	
3		r and volume of test can.			2.
4	Note room temp (de		708	ı	
5		osig test\Moore ME 2020 RTG		-	
6			ite 106-C vessel for 30 psig pulse.	1	
7	Note charging pressu		Pressure (psig): 37 PSIZ		
8		will not initially be pressure ch	parged	1	
9		n, to not charge vessel 106-C.	in bear	1	
10		ed, to not charge vessel 106-C			1
-	In Process Steps	ed, to not charge vesser 100 c			1
11	Prepare container to	be tested.		V	2
12		ball valve on vessel 106-C.			2
13		door. Seal with "In Use" yello	ow tape.		2
14					
.5	Turn on air compress	or,			
.6	Adjust regulator PCV	1 and use PRV1 to set chargin	g pressure, if needed:	1	
L7	Set and record wind t			1	
18					
19	Note valve V5 is close	ed, to charge vessel 106-C.			
20	Note valve V6 is oper	n, to charge vessel 106-C.		1	
21		erite 106-C is pressurized.			
22		00	Pressure (psig): 37	1	
_	Verify charging (syste		Pressure (psig): 3+	1	-
!3	Turn aerosol particle	counter on.		i	
24	Create filename with	format: Logook and page, tes	st series and ID info.		
25	Start AIM software fo	or drop test sampling (60 sec	count, 90 count cycles)	1	
26		tration validation. Note five c		1	
27	SN; 03-06-08	3154 Lid : NUCFIL-0	192 -08 LANL 2143		
28			or a one to two second pulse.	,	2
.9	Note sample number	of aerosol particle counter.	Sample number at pulse: 6:TH	1(0.	2 mg/m3
0	He-test	Total Mass 5239.	80.		100
	Post-test Steps				
1		d file names and location			
2		about 1.0E-5 mg/m^3 before	opening door.		
3	Open RRFMC door			×	2
4	(Optional) DR measur			50	
5	(Optional) DR Measur				
6		off and open bleed valve.			
7	Perform post-test act				
8	RRFMC data analysis		10 ===		1
	F-755 T- 12) 1	- Total Mast 523	4.99 500		
	Date: 12-9-20	20	Assistant 2: J NAVIS		***************************************
	Logbook: D. 131	Moore Nuc Fil - 6	Assistant 3:	- Agency (Personal)	
		MOORE	Assistant 4:		
		operator number after com			
Minara	PRE-BKG = 1	3.4×10 to mg/m3 @ 8.8	3×10-8 mg/m3 3 15 ×10-8 4 1.8×10-6	5) 4x10	-7 mg/m
30	4.9x10-5 mg/3	(24) 4.4×10-5 mg/m3 (25)6,	3x105 mg/m326 3.7x10-5 mg/m22	7) 4.3 XII	5 mg/n
٧	5.7 NO-5 30 20		32) 1.8×10-5 33 4.5×10-5 34	75	





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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of analytical cerium oxide test powder.

	Preliminary Steps	HAGAN:	3BD	Note	Operator number	Assistant number
1	Walk through room 1	03 and organize work ar			1	
2	Record the date, operator, logbook name & page.				1	
3		and volume of test can.				2
4	Note room temp (deg F).			704		
5	Z:\RTG in a Can - 30 p	sig test\Moore ME 2020	RTG in a	Can - 30 psig test.xlsx	/	
6	Calculate charging pressure for gray 9 gallon Drierite 106-C vessel			6-C vessel for 30 psig pulse.	V1	
7	Note charging pressure (psig): 37 psig Pressure (psig): 37 psig					
8	Ensure vessel 106-C will not initially be pressure charged.				V	
9	Note valve V5 is open, to not charge vessel 106-C.				V-1	
10		d, to not charge vessel 1			1	
	In Process Steps					
11	Prepare container to	be tested.	10000000000000000000000000000000000000	9 (finesos)		2
12	Install test can above ball valve on vessel 106-C.		-C.			2
13	Close and lock tower	door. Seal with "In Use'	yellow ta	pe.	20 10000	2
14						
15	Turn on air compresso				1	
16	Adjust regulator PCV1	and use PRV1 to set ch	arging pre	ssure, if needed:	1	
17	Set and record wind t	unnel speed (Hz):	N. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	27 (27 HZ		
18						
19	Note valve V5 is close	d, to charge vessel 106-	C.		[	
20		, to charge vessel 106-C			1	
21		erite 106-C is pressurized	ti-mintenani		1	
				25.5.7	1 .	
22	Verify charging (syste	m) pressure on PI3:	37	Pressure (psig): 37 \$516		
23	Turn aerosol particle	counter on.			1	
24	Create filename with	Create filename with format: Logook and page, test series and ID info.				
25	P. C. Company of the	r drop test sampling (60			1	
26		tration validation. Note				
27		54, Lia: DUEFTL -				
28						
				one to two second pulse.	4 (2) = -	11/2
29		of aerosol particle coun		Sample number at pulse: 8TH	1 (0.20	mg/m3)
30	Pre- 1854 1	otal Mass 5330	144			
21	Post-test Steps	(fi)				
31 32	Save data files, record					
33	Verify background is a Open RRFMC door					
34	(Optional) DR measure	omont				
35	(Optional) DR Measur					
36		ff and open bleed valve.				
37	Perform post-test acti					
38	RRFMC data analysis a				20270 70 70 10 1	
,,,	That the data dilarysis to	and test report.				
	Date: 12-9-20	NUCTI Moore -C	18	Assistant 2: J DAVIS		
	Logbook: P. 131	nuctil Morre - a	2	Assistant 3:		
				Assistant 4:		
	Note: Only record the	operator number after	completio	ASSISTANT 4: on of the step.   6  10 - 5 (4) (3 × 10 - 5 (5)   6  13   5  3 + 10 - 5 (35)		
30-	and Outre	5 ma /m 2 (5) 1 2x 10	5 15.	1-5 (1) 12 125 (A)	10.0-5	Q o c .





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Pre test





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Post test





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	Preliminary Steps 11A-An 11TH	Note	Operator	Assistant
		Note	number	number
1	Walk through room 103 and organize work area.		1	
2	Record the date, operator, logbook name & page.			
3	Record serial number and volume of test can.			2
4	Note room temp (deg F).	70°F		
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a C	an - 30 psig test.xlsx		
6	Calculate charging pressure for gray 9 gallon Drierite 106			
7	Note charging pressure (psig): つかい	Pressure (psig): 37 psig	, ,	
8	Ensure vessel 106-C will not initially be pressure charged.		V	
9	Note valve V5 is open, to not charge vessel 106-C.		V 1	
10	Note valve V6 is closed, to not charge vessel 106-C.		V 4	
	In Process Steps			
11	Prepare container to be tested.			2
12	Install test can above ball valve on vessel 106-C.			2
13	Close and lock tower door. Seal with "In Use" yellow tap	e.	-	2
14	T		1	
15	Turn on air compressor.	:f	1	
16 17	Adjust regulator PCV1 and use PRV1 to set charging press Set and record wind tunnel speed (Hz):		1	
18	Set and record wind turner speed (Hz).	27 42	-	
19	Note of Mr. 1 and 1 and 1 and 1		1	
_	Note valve V5 is closed, to charge vessel 106-C.		1	
20	Note valve V6 is open, to charge vessel 106-C.		l l	
21	Verify gray vessel Drierite 106-C is pressurized.		1	
22	Verify charging (system) pressure on PI3: 37 9514	Pressure (psig): 37-psig	1	
23	Turn aerosol particle counter on.	10	1	
24	Create filename with format: Logook and page, test serie	1		
25		1		
26	Start AIM software for drop test sampling (60 sec count, Pre-drop BKG concentration validate 1.0E-5 mg/m3. Note	-		
			.1	
27	SNI NEW MEIGHT WITHOUT TO SNIGHT	10 (ANIL:2013A)		
	SN: 08-06 08154, Lid: NICFIL-019-2-0	18 4/10-30 Kg	-	
28	Toggle ball valve above gray vessel Drierite 106-C for a or	ne to two second pulse.		2
29	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.	ne to two second pulse. Sample number at pulse: 674	\$ (0,14	2 (mg/m3)
	Toggle ball valve above gray vessel Drierite 106-C for a oi Note sample number of aerosol particle counter. Pre-Tosk rok Mass 5416.0 a	ne to two second pulse.	\$ (0.14	2 mg/m3)
29 30	Toggle ball valve above gray vessel Drierite 106-C for a oi Note sample number of aerosol particle counter. Pre Tosh Mwss5416.0 み Post-test Steps	ne to two second pulse.	\$ (0.14	2 (mg/m3)
29 30 31	Toggle ball valve above gray vessel Drierite 106-C for a oi Note sample number of aerosol particle counter. Pre Tosh イルンジラサリル・ロット Post-test Steps Save data files, record file names and location	ne to two second pulse.  Sample number at pulse: 61H	\$ (0.14)	2 (mg/m3)
29 30 31 32	Toggle ball valve above gray vessel Drierite 106-C for a oi Note sample number of aerosol particle counter. Prと てなた イロー M いままり 16.0 の Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin	ne to two second pulse.  Sample number at pulse: 61H	\$ (0.14)	2 (mg/m3)
29 30 31 32 33	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter. Pre Trsh mass 416.0 or Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door	ne to two second pulse.  Sample number at pulse: 61H	\$ (0.14)	2 (mg/m3)
29 30 31 32 33 34	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter. Pでとってまた いか M かがら与れる。 Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door (Optional) DR measurement	ne to two second pulse.  Sample number at pulse: 61H	\$ (0.14)	2 tng/m3)
29 30 31 32 33 34 35	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter. Pre-Tosh Ind Mass 5416.0 or Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before opening Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter.	ne to two second pulse.  Sample number at pulse: 61H	\$ (0,14	2 mg/m3)
31 32 33 34 35 36	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre-Tosh Ind Mass. 5416. Oay Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before opening Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve.	ne to two second pulse.  Sample number at pulse: 61H	4 (0.11)	2 my/m3)
29 30 31 32 33 34 35	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre Tosh Aussishile. Our Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve. Perform post-test activities	ne to two second pulse.  Sample number at pulse: 61H	4 (0.11)	2 (mg/m3)
29 30 31 32 33 34 35 36 37	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre-Tosh Ind Mass. 5416. Oay Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before opening Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve.	ne to two second pulse.  Sample number at pulse: 61H	4 (0.11)	2 mg/m3)
29 30 31 32 33 34 35 36 37	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre Tosh Aussishile. Our Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve. Perform post-test activities	ne to two second pulse.  Sample number at pulse: 61H	4 (0.14)	2 my[m3]
29 30 31 32 33 34 35 36 37	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre Tosh Aussishile. Our Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve. Perform post-test activities	ne to two second pulse.  Sample number at pulse: 61H	4 (0.14)	2 (mg/m3)
29 30 31 32 33 34 35 36 37	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre-Tosh I M M M SHII. O M Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve. Perform post-test activities RRFMC data analysis and test report.  Date: Q 700	ne to two second pulse.  Sample number at pulse: 61H  ng door.	4 (0.14)	2 (my/m3)
29 30 31 32 33 34 35 36 37	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre-Tosh I M M M SHII. O M Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve. Perform post-test activities RRFMC data analysis and test report.  Date:	ne to two second pulse.  Sample number at pulse: GTH  g door.  Assistant 2: Dows.	4 (0.14)	2 (ny   <sub>193</sub> )
29 30 31 32 33 34 35 36 37	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre Tosh In Mass 5416. Oay Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve. Perform post-test activities RRFMC data analysis and test report.  Date:	Assistant 2: Assistant 4:  no f the step  Assistant 4:	4 (0,11)	
29 30 31 32 33 34 35 36 37	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre Tosh In Mass 5416. Oay Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before openin Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve. Perform post-test activities RRFMC data analysis and test report.  Date:	Assistant 2: Assistant 3: Assistant 4: nof the step 3.3 x 10 3		
29 30 31 32 33 34 35 36 37 38	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  PTX-TSF TAM MASS-\$416.0 \( \text{O} \) Post-test Steps  Save data files, record file names and location  Verify background is about 1.0E-5 mg/m^3 before opening open RRFMC door  (Optional) DR measurement  (Optional) DR Measurement filter.  Turn air compressor off and open bleed valve.  Perform post-test activities  RRFMC data analysis and test report.  Date:	Assistant 2: Assistant 3: Assistant 4: n of the step 3 3 10 3 8 30 000 100 100 100 100 100 100 100 100	O pola - R3 xisxiS	5 BK
29 30 31 32 33 34 35 36 37 38	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  PTX-TSF TAM MASS-\$416.0 \( \text{O} \) Post-test Steps  Save data files, record file names and location  Verify background is about 1.0E-5 mg/m^3 before opening open RRFMC door  (Optional) DR measurement  (Optional) DR Measurement filter.  Turn air compressor off and open bleed valve.  Perform post-test activities  RRFMC data analysis and test report.  Date:	Assistant 2: Assistant 3: Assistant 4: n of the step 3 3 10 3 8 30 000 100 100 100 100 100 100 100 100	O pola - R3 xisxiS	5 BK
29 30 31 32 33 34 35 36 37 38	Toggle ball valve above gray vessel Drierite 106-C for a or Note sample number of aerosol particle counter.  Pre Tosh I and Mass. 5416. Oay Post-test Steps Save data files, record file names and location Verify background is about 1.0E-5 mg/m^3 before opening Open RRFMC door (Optional) DR measurement (Optional) DR Measurement filter. Turn air compressor off and open bleed valve. Perform post-test activities RRFMC data analysis and test report.  Date:  D	Assistant 2: Assistant 3: Assistant 4: n of the step 3 3 10 3 8 30 000 100 100 100 100 100 100 100 100	O pola - R3 xisxiS	5 BK





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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of



Pre test





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Post test





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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of

	Preliminary Steps HAY AND 5TH	Note	Operator	Assistant
-	7//19/11/		number	number
1	Walk through room 103 and organize work area.		1	
2	Record the date, operator, logbook name & page.		<u>'</u>	2
3	Record serial number and volume of test can.	-7 + 0-		
4	Note room temp (deg F).	70%	1	
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a		1	
6	Calculate charging pressure for gray 9 gallon Drierite 10		1	
7 8	Note charging pressure (psig): 37-95 ( 6	Pressure (psig):	V	
	Ensure vessel 106-C will not initially be pressure charged	d		
9	Note valve V5 is open, to not charge vessel 106-C.		Ì	
10	Note valve V6 is closed, to not charge vessel 106-C. In Process Steps			
11	Prepare container to be tested.			2
12	Install test can above ball valve on vessel 106-C.			2
13	Close and lock tower door. Seal with "In Use" yellow ta	pe.		2_
14				
15	Turn on air compressor,		1	
16	Adjust regulator PCV1 and use PRV1 to set charging pre	ssure, if needed:	1	
17	Set and record wind tunnel speed (Hz):	27 HZ		
18				
19	Note valve V5 is closed, to charge vessel 106-C.		1	
20	Note valve V6 is open, to charge vessel 106-C.		1	
21	Verify gray vessel Drierite 106-C is pressurized.		1 -	
22	Verify charging (system) pressure on PI3:	Proceura (neigh:		)
23		Pressure (psig):	1	
	Turn aerosol particle counter on.		~ 7	
24	Create filename with format: Logook and page, test series and ID info.		1	
25	Start AIM software for drop test sampling (60 sec count		1	
26	Pre-drop BKG concentration validate 1.0E-5 mg/m3. No			
27	SN:08-26 08154 Lid: NGCFIL-03	10/02 LAWL 2062		
28	Toggle ball valve above gray vessel Drierite 106-C for a	one to two second pulse.		
29	Note sample number of aerosol particle counter.	Sample number at pulse 9.74	7.6×10	-2mg
30	DEC-TEST MASS 5388.00		'	m3
	Post-test Steps			
31	Save data files, record file names and location			
32	Verify background is about 1.0E-5 mg/m <sup>3</sup> before open	ing door.		
33 34	Open RRFMC door			
35	(Optional) DR measurement (Optional) DR Measurement filter.			
36	Turn air compressor off and open bleed valve.			
37	Perform post-test activities			
38	RRFMC data analysis and test report.			
				Samuel Control
	Date: 12-9-20 Assistant 2: J DAVIS			AAAAA AAAA CARAAAA AAAA AAAA
	Logbook: P.131 Mare Nucht-(p Assistant 3:			
	Operator 1: M MODRE	James Committee	2000-2000000	
	Note: Only record the operator number after completion	on of the step.		
6	3 x10-5 mg/m3	(7) 4.0 x 10-5 m3/m	3	
١.	\\dcstorage.lanl.gov\ta55\SAVY-4000 Lifetime Extension\RTG in a C	an - 30 psig test (Punchlist - RTG in a Can - 30	psig - R3.xlsx]S	heet1
16	1x10-5 mg/m3(29) 1,1x10-4 (30 1,0x10-5)	3/1.0 × 10-9 32 6.2×10-5	33/6,7×10-5	mg/m3
0	1×10-1 85784410-5 36 54410-5	(37 6.6 × 10-5 (38) 4.2	X10-5 W	9 m3
1.	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
1.1	3 x 10 -5 m/m <sup>3</sup> \\destruction \text{1/m <sup>3</sup> } \\deta	71x 10-5 (43) 70 5 mg.	3/4	× / ·





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Opera	tion procedure punchlist and container information sheet	t. (RTG in a can - 30 psig series)	Operator	Assistant
	Preliminary Steps AGAN 67H.	Note	number	number
1	Walk through room 103 and organize work area.			
2	Record the date, operator, logbook name & page.			
3	Record serial number and volume of test can.			2
4	Note room temp (deg F).	705		183
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a Ca			
6	Calculate charging pressure for gray 9 gallon Drierite 106		1	
7		Pressure (psig):		
8	Ensure vessel 106-C will not initially be pressure charged.	$\checkmark$	1	
9	Note valve V5 is open, to not charge vessel 106-C.			
10	Note valve V6 is closed, to not charge vessel 106-C.		i i	
	In Process Steps			
11	Prepare container to be tested.		Annual Company (Company Company Compan	2
12	Install test can above ball valve on vessel 106-C.			2
13	Close and lock tower door. Seal with "In Use" yellow tap	е.		2_
14				
15	Turn on air compressor.		1	
16	Adjust regulator PCV1 and use PRV1 to set charging press	sure, if needed:	J.	
17	Set and record wind tunnel speed (Hz):	27 42		
18				
19	Note valve V5 is closed, to charge vessel 106-C.	300000000000000000000000000000000000000		
20	Note valve V6 is open, to charge vessel 106-C.		1	
21	Verify gray vessel Drierite 106-C is pressurized.		1	
22		Pressure (psig): 37 PS16		
	Verify charging (system) pressure on PI3:	Pressure (psig): 34 (316	$\overline{}$	
23	Turn aerosol particle counter on.			
24	Create filename with format: Logook and page, test serie	s and ID info.	1	
25	Start AIM software for drop test sampling (60 sec count,	90 count cycles)		
26	Pre-drop BKG concentration validate 1.0E-5 mg/m3. Note	e five cycles of 1 min.	1	
27	50:08 DE 08154 Lid; NIM FEL-013 10/02	LWL 3213		
28	Toggle ball valve above gray vessel Drierite 106-C for a or	ne to two second pulse.		
29	Note sample number of aerosol particle counter.	Sample number at pulse: (874)	8.2×10	-2 mg/m3
30	PR-TEST TOTAl MUSS SHISTE			UTT
	Post-test Steps  Standard Stan	5415.60/		
31	Save data files, record file names and location	P of payments of the second		
32	Verify background is about 1.0E-5 mg/m <sup>3</sup> before opening	ng door.		
33	Open RRFMC door			
34	(Optional) DR measurement			
35	(Optional) DR Measurement filter.			
36	Turn air compressor off and open bleed valve. Perform post-test activities			
37	RRFMC data analysis and test report.		or market	
30	nnrive data analysis and test report.			
	Date: 12-9-20	Assistant 2: J DANS		
	Logbook: p. 31 MOORE NACFIL G	Assistant 3:		
	Operator 1: M Moore	Assistant 4:		
D 1.1 FD 8	Note: Only record the operator number after completion  NOT My /m3 (3) 412 X10 5 (4) 2.1 X10 -5 (5) 2.  \\delta \text{Note: Apple of the Extension   RTG in a Ca.}  9 X10 -5 m3 /m3 (43) 1/1 X10 -4 (44) (6.4X10)  3.5 X10 -5 m3 /m3 (48) 418 X10 -5 m3/m3 (4)	n of the step.  1.3 × 10 - 5 (b) 1.7 × 10 - 5  1.3 × 10 - 5 (b) 1.7 × 10 - 5  1.3 × 10 - 5 (c) 1.7 × 10 - 3  1.5 × 10 × 10 - 5 (16) 3.4 × 10	) 1,5×10° 3 psig - R3.xlsx}s	mg/m3 heet1
17				
	Post-Test Find Mars	15415.7g) 570		





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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of

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Pre test





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	Preliminary Steps S MY 15T	Note	Operator	Assistan	
		Note	number	number	
1	Walk through room 103 and organize work area.				
2	Record the date, operator, logbook name & page.		1		
3	Record serial number and volume of test can.				
4	Note room temp (deg F).	10°F			
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a C	Can - 30 psig test.xlsx	V		
6	Calculate charging pressure for gray 9 gallon Drierite 106	1	1		
7	Note charging pressure (psig): 34 P516	Pressure (psig): 24			
8	Ensure vessel 106-C will not initially be pressure charged	<u>,                                    </u>	V		
9	Note valve V5 is open, to not charge vessel 106-C.				
10	Note valve V6 is closed, to not charge vessel 106-C.		_1		
	In Process Steps				
11	Prepare container to be tested.			2	
12	Install test can above ball valve on vessel 106-C.			2	
13 14	Close and lock tower door. Seal with "In Use" yellow tap	e.		2	
15	Turn on air compressor.		1		
1.6	Adjust regulator PCV1 and use PRV1 to set charging pres	sure if needed:			
17	Set and record wind tunnel speed (Hz):	27 HZ		2333	
18	ortalia record tilla tallio speca (ria).	DI HILL			
19	Note valve V5 is closed, to charge vessel 106-C.		1		
20					
	Note valve V6 is open, to charge vessel 106-C.		1.	-	
21	Verify gray vessel Drierite 106-C is pressurized.		1		
22	Verify charging (system) pressure on PI3:	Pressure (psig): 35 PSIG	1		
23	Turn aerosol particle counter on.				
24	Create filename with format: Logook and page, test serie	es and ID info.	1		
25	Start AIM software for drop test sampling (60 sec count,	1			
26	Pre-drop BKG concentration validate 1.0E-5 mg/m3. Not		i i		
27	011305006 B, 081305135L				
28	Toggle ball valve above gray vessel Drierite 106-C for a o			2	
29	Note sample number of aerosol particle counter.	Sample number at pulse:	8.2×10		
30	PR-1851 Mass 4590.5 as Total	Sample number at pulse.	0.2 200	14	
50	Post-test Steps				
31	Save data files, record file names and location				
32	Verify background is about 1.0E-5 mg/m^3 before openi	ng door.		)	
33	Open RRFMC door				
34	(Optional) DR measurement				
35	(Optional) DR Measurement filter.				
36	Turn air compressor off and open bleed valve.		,		
37	Perform post-test activities				
38	RRFMC data analysis and test report.				
	Date: 12-9-20 Assistant 2: J DAV IS				
	Logbook: D.131 Morre-Nucfil 6	Assistant 3;			
	Operator 1: M Morrie Assistant 4:				
	Note: Only record the operator number after completion	on of the step.			
	8 x 10 ~ 5 ~ 9/m3 (D) 1 ,7 x 10 ~ 5 (3) 1 ,9 x 10 ~ 5 (4) 1.   Ndestorage.lanl.gov  1055  SAVY-4000 Lifetime Extension  RTG in a Ca D x 10 ~ 5 ~ mg/m3 (0) 1 ,6 x 10 ~ 5 (1) 4 ,2 x 10 ~ 6	6×10-5 (5) 3,5×10-5	0 psig - R3.xlsx]S	iheet1	
	Post-Test Find Mus 5 (45			- /**	





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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of



Pre test



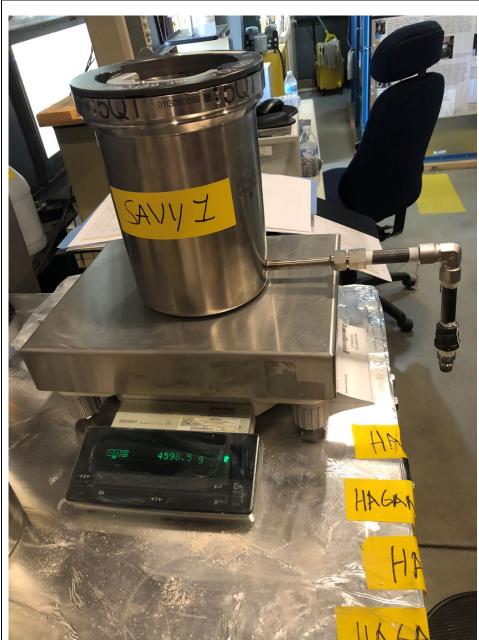


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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of

analytical cerium oxide test powder.



Post test





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	Preliminary Steps CMIV 2000	Note	Operator	Assistan		
1	2/11/		number 1	number		
1	Walk through room 103 and organize work area.		7			
2	Record the date, operator, logbook name & page.			2		
3	Record serial number and volume of test can.	7000		-		
4	Note room temp (deg F).	70°F				
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a C		/	-		
6	Calculate charging pressure for gray 9 gallon Drierite 106	I				
7	Note charging pressure (psig): 34 0515	Pressure (psig):	1			
8	Ensure vessel 106-C will not initially be pressure charged		7	-		
9	Note valve V5 is open, to not charge vessel 106-C.		LI	1		
10	Note valve V6 is closed, to not charge vessel 106-C. In Process Steps		1 1	1		
11	Prepare container to be tested.	Proposition and the second sec		2		
12	Install test can above ball valve on vessel 106-C.		100 Company (100 Company)	2		
13	Close and lock tower door. Seal with "In Use" yellow tap	P :		2		
14	costs and rock tower doors seen with an ose years top					
15	Turn on air compressor.		1			
16	Adjust regulator PCV1 and use PRV1 to set charging pres	sure, if needed:				
17	Set and record wind tunnel speed (Hz):	27 HZ				
18						
19	Note valve V5 is closed, to charge vessel 106-C.		1			
20	Note valve V6 is open, to charge vessel 106-C.		i			
21	Verify gray vessel Drierite 106-C is pressurized.		i			
		Bo C				
22	Verify charging (system) pressure on PI3: 34 \$516	Pressure (psig): PSIG		-		
23	Turn aerosol particle counter on.		1			
24	Create filename with format: Logook and page, test serie	es and ID info.	1			
25	Start AIM software for drop test sampling (60 sec count,	90 count cycles)	1			
26	Pre-drop BKG concentration validate 1.0E-5 mg/m3. Not			1		
27	SN. 011305006B, 081305135L					
28	Toggle ball valve above gray vessel Drierite 106-C for a o	ne to two second nulse				
29	Note sample number of aerosol particle counter.	Sample number at pulse:	1. 5.	0 × 10-4		
30	Fre-Test Mass Total 4604, 4cy		2			
	Post-test Steps					
31	Save data files, record file names and location					
32	Verify background is about 1.0E-5 mg/m^3 before openi	ng door.				
33	Open RRFMC door					
34	(Optional) DR measurement					
35	(Optional) DR Measurement filter.		)			
36	Turn air compressor off and open bleed valve.					
37	Perform post-test activities					
38	RRFMC data analysis and test report.					
	Date: 12-9-20	Assistant 2: JAVIS				
	Logbook: P, 131 Moore Nuctille	Assistant 3:				
	Operator 1: M MOORE	Assistant 4:				
	Note: Only record the operator number after completion of the step.					
16	SX10-4 7/m3 39.6x10-64 1,2x10-6 3	1.8×10-66	)   02 ut-ut	Chart		
)1 =	\\destorage.lanl.gov\ta55\SAVY-4000 Lifetime Extension\RTG in a Ca	1.8 × 10 T (3) 5 vb × 10	le my/m3	oneet1		
113	Dust-Test Find Moss [4604, 40]		0.05/*/			
	/\ /~\ T:\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	1 -/-				



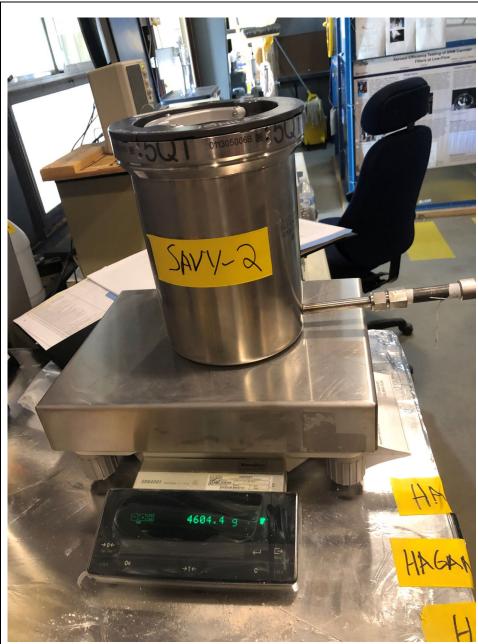


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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of

	Preliminary Steps SAVY 3AM	Note	Operator	Assistant		
			number	number		
1	Walk through room 103 and organize work area.	1	1			
2	Record the date, operator, logbook name & page.		1			
3	Record serial number and volume of test can.	- 65		2		
4	Note room temp (deg F).	707				
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a C		•			
6	Calculate charging pressure for gray 9 gallon Drierite 10		1			
7	Note charging pressure (psig): 34	Pressure (psig): 34	17.4			
8	Ensure vessel 106-C will not initially be pressure charged	d.	V1			
9	Note valve V5 is open, to not charge vessel 106-C.		1			
10	Note valve V6 is closed, to not charge vessel 106-C.		1			
	In Process Steps			- 22		
1	Prepare container to be tested.			2		
.3	Install test can above ball valve on vessel 106-C. Close and lock tower door. Seal with "In Use" yellow ta		- Control of the Cont	2		
L4	close and lock tower door. Seal with in ose yellow tap	Je.				
15	Turn on air compressor.		1			
16	Adjust regulator PCV1 and use PRV1 to set charging pre-	ssure, if needed:	1			
17	Set and record wind tunnel speed (Hz):	1 2742				
18	()	The state of the s				
19	Note valve V5 is closed, to charge vessel 106-C.					
20						
	Note valve V6 is open, to charge vessel 106-C.		<u> </u>	p) 118000		
21	Verify gray vessel Drierite 106-C is pressurized.	661110	1			
22	Verify charging (system) pressure on PI3:	Pressure (psig): (34 ×16)				
23	Turn aerosol particle counter on.					
24	Create filename with format: Logook and page, test seri	11				
25	Start AIM software for drop test sampling (60 sec count,	i	<u></u>			
26	Pre-drop BKG concentration validate 1.0E-5 mg/m3. No	1				
27	5N:0113050066, D81305135L					
28	,					
29	Toggle ball valve above gray vessel Drierite 106-C for a c Note sample number of aerosol particle counter.	Somple number at pulse.	i Han	4		
30	Pie-Test 12th M 455 45	Sample number at pulse (711)	1,4x10-	71		
30	Post-test Steps	70 47.49				
31	Save data files, record file names and location					
32	Verify background is about 1.0E-5 mg/m^3 before open	ing door.				
33	Open RRFMC door					
34	(Optional) DR measurement					
35	(Optional) DR Measurement filter.					
36	Turn air compressor off and open bleed valve.					
37	Perform post-test activities					
38	RRFMC data analysis and test report.					
	D . AO O A -	+ + + + + + + + + + + + + + + + + + + +				
	Date: 12-9-20	Assistant 2: J DAWS				
	Logbook: p. 13) Moore Nuc File Operator 1: Moore	Assistant 4:				
	Operator 1: Methe   Assistant 4:     Note: Only record the operator number after completion of the step.					
) 2			0 psia - R3.xlsx15	Sheet1		
66	1x10-6 mg/m3 (10) 1.0 x10-6 (11) 2.3 x10-6	(D) 3.0 x 10 - (13) 8.1	x10-7 mg	1/m3		
D 1 9 6	.2×10 5 mg/n3 3 6,9 ×10 7 mg/m3 4 5,3 ×1 Ndcstorage.tanl.gov\ta55\SAVY-4000 Lifetime Extension\RTG in a Co	or 5 M. 5 x 10 4 6 1.1 y an - 30 psig test\[Punchlist - RTG in a Can - 3 (W) 3,0 x 10 4 (13) 8.1	10-5 0 psig - R3.xls 110-7 Y	[x]S		





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Calculation Title: Pressurizing Hagan and SAVY containers to 30-psig to measure the release of

	Preliminary Steps SAVY UTH	Note	Operator number	Assistant number		
1	Walk through room 103 and organize work area.		1			
2	Record the date, operator, logbook name & page.		1			
3	Record serial number and volume of test can.			2		
4	Note room temp (deg F).	7005	1			
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a					
6	Calculate charging pressure for gray 9 gallon Drierite 10		1			
7	Note charging pressure (psig): 34 P51 G					
8	Ensure vessel 106-C will not initially be pressure charged					
9	Note valve V5 is open, to not charge vessel 106-C.		11			
10	Note valve V6 is closed, to not charge vessel 106-C.		1			
	In Process Steps					
11	Prepare container to be tested.			2		
12	Install test can above ball valve on vessel 106-C.			2		
13	Close and lock tower door. Seal with "In Use" yellow ta	pe.		2		
14				. 39.9%		
15	Turn on air compressor.		1			
16	Adjust regulator PCV1 and use PRV1 to set charging pre-	7	1			
17	Set and record wind tunnel speed (Hz):	27 92				
18		7				
19	Note valve V5 is closed, to charge vessel 106-C.		1			
20	Note valve V6 is open, to charge vessel 106-C.		1			
21	Verify gray vessel Drierite 106-C is pressurized.					
22	Verify charging (system) pressure on PI3:	Pressure (psig):				
23		ressure (psig).	1			
	Turn aerosol particle counter on.		1			
24	Create filename with format: Logook and page, test seri	1				
25	Start AIM software for drop test sampling (60 sec count,	1				
26	Pre-drop BKG concentration validate 1.0E-5 mg/m3. No	te five cycles of 1 min.				
27	SN:012005 124 B/L					
28	Toggle ball valve above gray vessel Drierite 106-C for a c	one to two second pulse.				
29	Note sample number of aerosol particle counter.		3,0x10-5			
30	Pre-105+ 12tal MOSS 4644.4g			İ		
	Post-test Steps					
31	Save data files, record file names and location			111111111111111111111111111111111111111		
32	Verify background is about 1.0E-5 mg/m <sup>3</sup> before open	ing door.		and the second s		
33	Open RRFMC door					
34	(Optional) DR measurement					
35	(Optional) DR Measurement filter.					
36	Turn air compressor off and open bleed valve.					
37	Perform post-test activities					
38	RRFMC data analysis and test report.	7		1		
	Date: 12-9-20	Assistant 2: J DAVIS				
	Logbook: D.131 Moore NUCFIL-6	Assistant 3:				
	Logbook: p. 13  Moore NUCF(  G Assistant 3: Operator 1: M Moorle Assistant 4:					
	Note: Only record the operator number after completion of the step.					
2	.4×10-5- Mg/m3(3) \\destorage.lanl.gov\tas=\SAVY-4000 Lifetime Extension\RTG in a Co	an - 30 psig test\[Punchlist - RTG in a Can - 3	8	iheet1		
,	1 x10-6 mg/m3 (0) 2,9 x10-5 (1) 25x10-6 m	10/2 (70)	Jo			





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	Preliminary Steps SAVY 5TH N	lote	Operator	Assistant
			number	number
1	3 3		1	
2				
3	The second secon	7 /2 -		2
4	1	70°F		
5	and the control of th			
7	0.01 0.7.0	ressure (psig):		
8		ressure (psig).	1	
9		unione de la companya	+i-	
1	Trace valve 13 is open, to not unarge vessel 200 of		1	
1	In Process Steps			
1				2
1			Prince Control Control	2
1				2
1				
1.				
1			1	
1		(27 HZ)		
1			1	
-	Tracto Tarro 15 is diosed, to criai go Tessor 200 ci		1	-
2				
2	Verify gray vessel Drierite 106-C is pressurized.		/	
2:	Verify charging (system) pressure on PI3:	ressure (psig): 35 PSL6		
2.	Turn aerosol particle counter on.		1	
2.	Create filename with format: Logook and page, test series	and ID info.	1	
2			h	
2	Start Ann Software for Grop test sampling (60 see count, 50		i	
2				
2			*	12
25	Toggie ban tarre above Bray vesser briefite 200 e for a one	ample number at pulse; &TH)	1.2×10	4
30		ample number at pulsa. & ( II )	[1007(0	
	Post-test Steps			
3	Save data files, record file names and location			
3:	Verify background is about 1.0E-5 mg/m^3 before opening	door.		
3:				
3				
3:			-	
31				
3				
	INTERIOR data analysis and test report.			
	Date: 12-9-2020 A	ssistant 2: J DAVIS		
		ssistant 3:		
	Operator 1: M MOORE A	ssistant 4:		
	Note: Only record the operator number after completion of	of the step.		
(3)	1.9 xf6-5 mg/m3 (4) S 2.3 x w 6 \\destorage.lanl.gov\ta55\SAVY-4000 Lifetime Extension\RTG in a Can-	(b) 3,5 x10-(c) (1) 4.4x10	- (g (g) ) psig - R3.xlsx)	Sheet1
(1)	3.7 ×10-6 (12) 3.2×10-6 (13) 3.11×10-6  Dost-Test Total Mass 14743.	(4) 9.2×10-6 (B)	, 00 mg	m3

SAVY 5<sup>th</sup>. Note the transcription error for the Post Test Total Mass (4743.3 g). The post-test photo captured the correct mass as 4734.3 g.





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Post test





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	Preliminary Steps SAIA 15TH	Note	Operator	Assistan		
	7111/011		number	number		
1	Walk through room 103 and organize work area.		1 !			
2	Record the date, operator, logbook name & page.		1			
3	Record serial number and volume of test can.			2		
4	Note room temp (deg F).	700				
5	Z:\RTG in a Can - 30 psig test\Moore ME 2020 RTG in a C	Can - 30 psig test.xlsx				
6	Calculate charging pressure for gray 9 gallon Drierite 106	S-C vessel for 30 psig pulse.				
7	Note charging pressure (psig):	Pressure (psig): 34 PSIG				
8	Ensure vessel 106-C will not initially be pressure charged	F)				
9	Note valve V5 is open, to not charge vessel 106-C.	tern stern) fantaver enseme district er sterning	1	317717-025-0		
10	Note valve V6 is closed, to not charge vessel 106-C.		1			
	In Process Steps					
11	Prepare container to be tested.	* control of California control of the California of the California of the California of California		2		
12	Install test can above ball valve on vessel 106-C.	3.400		2		
13	Close and lock tower door. Seal with "In Use" yellow tap	e.		2		
14						
15	Turn on air compressor.		1			
16	Adjust regulator PCV1 and use PRV1 to set charging pres		1			
17	Set and record wind tunnel speed (Hz):	27 112				
18			1			
19	Note valve V5 is closed, to charge vessel 106-C.		1			
20	Note valve V6 is open, to charge vessel 106-C.					
21	Verify gray vessel Drierite 106-C is pressurized.		1			
22		Pressure (psig): 35 PS 16				
	Verify charging (system) pressure on PI3:	Pressure (psig).	<del></del>			
23	Turn aerosol particle counter on.		1			
24	Create filename with format: Logook and page, test serie	es and ID info.	1			
25	Start AIM software for drop test sampling (60 sec count,	90 count cycles)	1			
26	Pre-drop BKG concentration validate 1.0E-5 mg/m3. Not	e five cycles of 1 min.	1			
27	SN:012005124 B/L	a la luci di stata di salam d	Terransian Communication			
28	Toggle ball valve above gray vessel Drierite 106-C for a o	ne to two second nulse				
29	Note sample number of aerosol particle counter.	Sample number at pulse: 81H				
30	Pre-Test Muss Total 4826, Ba					
	Post-test Steps	1				
31	Save data files, record file names and location					
32	Verify background is about 1.0E-5 mg/m^3 before openi	ng door.				
33	Open RRFMC door					
34	(Optional) DR measurement					
35	(Optional) DR Measurement filter.					
36	Turn air compressor off and open bleed valve.					
37	Perform post-test activities					
38	RRFMC data analysis and test report.			ļ		
	Date: 12-9-20	Assistant 2: J DAVIS		110 - 120 -		
	Logbook: P.131 MOORE NUCFIL-6	Assistant 3:				
	Operator 1: \ \ \ Mooke \ Assistant 4:					
)6	Note: Only record the operator number after completion   Txlo	no of the step.				
	TX10-6 mg/n3 (1) 2,3 X10-6 (1) 9,9 X10			sheet1		
. 11	Post-Test Total Mass [48					





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Post test





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## 13.0 FILES TO LOCATE METADATA INFORMATION.

- 1) "Z:\RTG 2ND 30 psig\AP-341-605-R4- Moore and Davis Dec 2020 Pressurizing Hagan and SAVY containers to 30-psig.docx"
- 2) "Z:\RTG 2ND 30 psig\2ND Excel calcs\2ND RTG in a can summary of tests.xlsx"
- "Z:\RTG 2ND 30 psig\2ND Excel calcs\Pre and Post container masses logbook and photos recorded.xlsx"

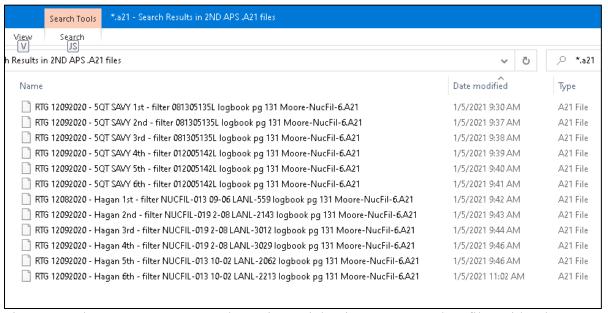


Figure 14. The TSI Inc. APS Aerodynamic Particle Sizer generates data files with a \*.A21 format extension. (e.g. "Z:\RTG 2ND - 30 psig\2ND APS .A21 files\RTG 12092020 - 5QT SAVY 1st - filter 081305135L logbook pg 131 Moore-NucFil-6.A21")



12/1/2020 4:26 PM



Calculation No.: CAL-21-TA55-CNTRC-008-M, R0

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> SAVY-4000 Lifetime Extension (\\dcstorage.lanl.gov\ta55) (Z:) > RTG 2ND - 30 psig > 2ND Excel calcs Ō Name Date modified all 2ND RTG in a can - summary of tests.xlsx 1/12/2021 3:37 PM 🕼 RTG 12092020 - Hagan 4th - filter NUCFIL-019 2-08 LANL-3029 logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 3:27 PM 🚮 RTG 12092020 - Hagan 6th - filter NUCFIL-013 10-02 LANL-2213 logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 3:21 PM 📳 RTG 12092020 - Hagan 5th - filter NUCFIL-013 10-02 LANL-2062 logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:59 PM 💵 RTG 12082020 - Hagan 1st - filter NUCFIL-013 09-06 LANL-559 logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:49 PM 🚮 RTG 12092020 - Hagan 3rd - filter NUCFIL-019 2-08 LANL-3012 logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:40 PM 🚮 RTG 12092020 - Hagan 2nd - filter NUCFIL-019 2-08 LANL-2143 logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:37 PM RTG 12092020 - 5QT SAVY 6th - filter 012005142L logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:23 PM 🚮 RTG 12092020 - 5QT SAVY 5th - filter 012005142L logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:18 PM 🕼 RTG 12092020 - 5QT SAVY 4th - filter 012005142L logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:15 PM 🕼 RTG 12092020 - 5QT SAVY 3rd - filter 081305135L logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:12 PM 🕼 RTG 12092020 - 5QT SAVY 2nd - filter 081305135L logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 2:06 PM 🚮 RTG 12092020 - 5QT SAVY 1st - filter 081305135L logbook pg 131 Moore-NucFil-6.xlsx 1/5/2021 12:28 PM Pre and Post container masses - logbook and photos recorded.xlsx 12/10/2020 1:47 PM

Figure 15. Excel spreadsheets to calculate the respirable mass values.

2ND punchlists